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CORRELATION BETWEEN PHYSICAL ACTIVITY, MUSCLE MASS, BODY FAT, AND BIOLOGICAL AGE

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ABSTRACT
Physical activity plays a crucial role in maintaining a healthy and balanced body, particularly in relation to body composition, including muscle mass, body fat percentage, and biological age. This study aims to analyze the relationship between physical activity levels and muscle mass, body fat and biological age within the population of Cihanjuang Rahayu Village. This research employed an observational design with a cross-sectional approach. Data collection was conducted using the Global Physical Activity Questionnaire (GPAQ), a bioimpedance device (BIO Omron), and height measurements. The Chi-Square test was utilized for data analysis to assess the relationships between the variables. The total population for the study consisted of 242 individuals, based on predetermined inclusion and exclusion criteria. A sample of 151 respondents was selected using the Slovin formula with a 5% margin of error. Based on the physical activity scores from the population of Cihanjuang Rahayu Village, the highest score was from learning/working activities, with an average value of 4.89. The distribution of muscle mass among the community members showed that 59.6% fell into the moderate category, with muscle mass ranging from 19.9 to 29.7 kg. Regarding body fat, 36.4% of the community was categorized as having healthy body fat. The biological age of the community members was mostly in the early elderly category, representing 33.1% of respondents. From the Chi-Square test, the relationships between physical activity and muscle mass (p-value > 0,05), physical activity and body fat (p-value > 0,05), and physical activity and biological age (p-value > 0.05) showed no significant associations between physical activity and these body components. Although there was no significant relationship found between physical activity and muscle mass, body fat, or biological age, physical activity still plays a vital role in promoting overall health and well-being.

Keywords: biological age; body fat; muscle mass; physical activity

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INTRODUCTION

Every movement we consciously make is considered part of physical activity. When we engage in physical movement, our muscles exert more effort, and we produce more energy. By exercising regularly, we can burn calories, reduce body fat, maintain a healthy weight, and even slow down the aging process (Rohani, D. 2023). Engaging in consistent physical activity not only improves cardiovascular health by reducing the likelihood of heart disease and stroke, but it also helps individuals feel more energetic and youthful. Furthermore, it strengthens muscles and bones, enhances joint flexibility, and contributes to an overall fitter and healthier body shape. (Reswari, A., Juanda, J., & Khair, A., 2024). These benefits help to counteract the decline in physical function that often accompanies aging. Additionally, physical activity is beneficial for mental health, as it reduces stress, improves mood, and promotes better sleep.

In 2018, the Riskesdas survey reported that 35% of Indonesians were inactive, and individuals with low physical activity have a 20% to 30% higher risk of death compared to those who are moderately active. Reduced physical activity is identified as the fourth leading cause of death globally, according to the World Health Organization (WHO). WHO recommends that adults aged 18 to 64 years engage in physical activity for at least 150 to 300 minutes per week

(Riskesdas, 2018). Physical activity involves movements that require energy expenditure through skeletal muscle work. Regular physical activity is essential for maintaining or even increasing muscle mass while reducing body fat across all age groups. As physical activity decreases, muscle mass tends to decrease and body fat increases, especially in older adults, as metabolism slows down. Therefore, older adults require regular, moderate-intensity physical activity to preserve muscle mass and prevent disease (Yuliadarwati, N. M., Agustina, M., Rahmanto, S., & Septyorini, S. 2020).

Physical activity, including light movements or aerobic exercises such as walking, brisk walking, running, cycling, and swimming, plays a crucial role in maintaining cardiovascular health and overall well-being (Hasanudin et al., 2018). These activities help improve cardiovascular function, maintain muscle strength, and regulate body composition. Engaging in regular physical activity has a significant impact on factors like body mass, body fat, and biological age. Body Mass Index (BMI), which is a commonly used method for assessing body composition, is calculated by dividing a person's weight (in kilograms) by their height squared (in meters) (Habut et al., 2016). Changes in BMI can be influenced by multiple factors, such as diet and physical activity levels. These factors may vary across age groups and genders, and physical activity plays an essential role in influencing BMI and body composition (Utara et al.,2021). Research has shown that these factors influence how individuals engage in physical activity, yet they may not fully capture the nuances across the entire age spectrum (Cotter & Lachman, 2010; Godin et al., 2008).

The habit of engaging in physical activity is crucial for the entire community, particularly for adults, who are the focus of this study. Regular, sustained physical activity tailored to an individual's age is essential for maintaining health. Individuals who are more physically active and engage in exercise consistently tend to have lower body mass, a healthier weight, reduced body fat, and may even slow down the aging process. This is linked to a range of physical, mental, and overall quality of life benefits (Muthmainnah, M. 2024). Physical activity is not merely a daily routine; it forms the foundation of overall health and well-being. Numerous studies have shown that appropriate physical activity provides not only physical benefits but also positively impacts mental and emotional health. Therefore, understanding the relationship between physical activity and body composition, such as body mass and body fat, has become an increasingly important area of research for both scientists and healthcare professionals (Rohani, D. 2023).

Age plays a significant role in shaping the relationship between physical activity and body composition. As individuals age, physiological changes, such as the loss of muscle mass (sarcopenia) and an increase in visceral fat, can alter the body's response to physical activity. These changes heighten the risk of developing obesity and related health conditions. Understanding how physical activity interacts with age to influence body composition is crucial for designing effective fitness programs, particularly for vulnerable populations like the elderly (Puspitasari, N., & Ariyanto, A. 2021). Despite extensive research on the relationship between physical activity and body composition, many complexities of the human body remain unexplored. Further studies and targeted interventions are necessary to address these gaps and to develop strategies that promote active and healthy lifestyles effectively within diverse communities. This study aims to explore the relationship between physical activity and key aspects of body composition—muscle mass, body fat, and biological age—in the population of Cihanjuang Rahayu Village.

METHOD

This research employed a quantitative method with an observational design and a cross-sectional approach. The analysis utilized the Chi-Square test to examine the relationships between variables. The study population comprised 160 individuals aged 30–60 years, selected using purposive sampling based on predetermined criteria. Prior to data collection, participants received a detailed explanation of the research objectives and provided informed consent. Data collection was conducted using validated and reliable instruments, including questionnaires with a Cronbach's alpha reliability score of 0,83 and a validity score of 0,52. After data collection, the responses were coded and analyzed using the Chi-Square test. The study adhered to ethical standards, as evidenced by the ethical clearance issued under reference number 380/KEPK-FIK.UNAI/EC/IV/24 by the Ethics Committee of Universitas Advent Indonesia.

RESULT

The study revealed findings on respondent characteristics, community activity scores, muscle mass categories, body fat levels, biological age, and the relationships between variables.

Tabel 1.
Demographic Characteristics Categorized by Gender

Gender	**f**	**%**
Female	99	65.6
Male	52	34.4

Table 1 presents the demographic overview of respondents, where the gender distribution shows that out of a total of 151 participants, females dominate with 99 individuals (65.6%), while males account for 52 individuals (34.4%).

Tabel 2.
Physical Activity Scores of the Cihanjuang Rahayu Village Population
Descriptive Statistics

Descriptive Statistics					
	N	Min	Max	Mean	Std. Deviation
AGE	151	30	60	40.73	9,320
Study/Work Activity Score	151	1	12	4.89	1,967
Commute to Activity Score	151	0	5	1.81	.846
Recreational Activity Score	151	1	10	2.62	1.264

Referring to Table 2, the Cihanjuang Rahayu Village population's activity score data shows that the age of participants ranged from 30 to 60 years, with an average of 40.73. The learning/work activity score ranged from 1 to 12, averaging 4.89. The score for travel to activities ranged from 0 to 5, with an average of 1.81, and the recreation score ranged from 1 to 10, with an average of 2.62.

Table 3.
Study/Work Activity

Variables	f	%
Activities during Study/Work		
Yes	33	21.9
No	118	78.1
Activities during Study/Work		
Dig not engage	118	78.1
4-7 days	10	6.6
3	22	14.6
7	1	0.7

Variables	f	%
Activities during Study/Work		
Under 1 hour	120	79.5
1-4 hours	17	11.3
5 hours	3	2.0
Above 5 hours	11	7.3
Activities during Study/Work		
Yes	117	77.5
No	34	22.5
Activities during Study/Work		
Did not engage	33	21.9
1-3 days	20	13.2
4-7 days	98	64.9
Activities during Study/Work		
Under 1 hour	33	21.9
1 hour - 4 hours	16	10.6
5 hours	102	67.5
Commute to activity places		
Yes	100	66.2
No	51	33.8
Commute to activity places		
Did not engage	51	33.8
4-7 days	23	15.2
3	77	51.0
Commute to activity places		
Under 1 hour	111	73.5
1-4 hours	37	24.5
5 hours	1	0.7
Above 5 hours	2	1.3
Recreational Activities		
Yes	33	21.9
No	118	78.1
Recreational Activities		
Did not engage	118	78.1
4-7 days	10	6.6
3	22	14.6
7	1	0.7
Recreational Activities		
Under 1 hour	122	80.8
1-3 hours	24	15.9
4-5 hours	1	0.7
Above 5 hours	3	2.0
Sedentary Activity		
Under 1 hour	13	8.6
1-3 hours	76	50.3
4-5 hours	49	32.5
Above 5 hours	13	8.6

From the data in Table 3, regarding physical activity during study or work in the Cihanjuang Rahayu village community, it was found that 117 respondents (77.5%) reported engaging in such activities, while 34 respondents (22.5%) did not. For travel to the place of activity, 100 respondents (66.2%) indicated they engaged in travel-related activity, while 51 respondents (33.8%) did not. As for recreational activities, 33 respondents (21.9%) reported participation, whereas 118 respondents (78.1%) did not engage in recreational activities.

Table 4.
Muscle Mass Categories

Category	f	%
Muscle Mass Category		
<19.9 kg (low)	26	17.2
19.9-27.7 kg (medium)	79	52.3
>27.7 kg (height)	46	30.5
Body Fat Composition Categories		
under fat	6	4.0
healthy	56	37.1
Over fat	48	31.8
obese	41	27.2
Biological Age Categories		
Early Adulthood	26	17.2
Late Adulthood	30	19.9
Early Elderly Stage	51	33.8
Late Elderly Stage	44	29.1

The distribution of muscle mass, body fat, and biological age in the Cihanjuang Rahayu village population showed that the majority, 79 respondents (52.3%), fell into the moderate muscle mass category. For body fat, 56 respondents (37.1%) were categorized as having a healthy level of fat. Regarding biological age, the early elderly category was the most common, with 51 respondents (33.8%) falling into this group.

Tabel 5.
Identifying the Relationship Between Physical Activity and Muscle Mass, Body Fat, and Biological age

Variable		Physical Activity			*P-value*
		Low	Moderate	High	
Muscle mass	Low	3	8	15	
	Moderate	15	33	31	0.510
	High	10	18	18	
Body fat	Underfat	0	2	4	
	Healthy	11	19	26	0.681
	Overfat	8	20	20	
	Obese	9	18	14	
Biological age	Early Adulthood	5	8	13	
	Late Adulthood	4	11	15	0.192
	Early Elderly Stage	7	27	17	
	Late Elderly Stage	12	13	19	

Based on the results presented in Table 5, the relationship between physical activity and muscle mass, body fat, and biological age was examined. The analysis showed that the correlation between physical activity and muscle mass had a p-value of 0,510, which is greater than 0.05, indicating that there is no significant relationship between the two variables. Similarly, the relationship between physical activity and body fat had a p-value of 0,681, suggesting that no significant correlation exists between these factors. Lastly, the relationship between physical activity and biological age returned a p-value of 0,192, which is also above 0,05, implying that there is no significant association between physical activity and biological age. Therefore, the results indicate that physical activity does not significantly impact muscle mass, body fat, or biological age in the study population.

DISCUSSION

Physical activity is a crucial component in maintaining individual health and well-being, especially as one ages. This study analyzes the relationship between physical activity and several variables, including age, learning activity scores, travel activity scores, and recreation

scores. Data obtained from 151 respondents show an age range between 30 and 60 years, with an average age of 40.73 years. This average reflects an adult population, for whom the level of physical activity and the need to maintain health are becoming increasingly important.

The results of the chi-square test revealed that there was no significant relationship between physical activity and muscle mass, body fat, and biological age. These findings align with research conducted by Deni et al. (2018) on the Banjaroyo Yogyakarta village population, where a p-value of 0.18 indicated no significant relationship between physical activity and body fat. Similarly, the study by Dealeka et al. (2023) on the adult population in the Special Region of Yogyakarta showed a p-value of 0.735, suggesting no significant relationship between physical activity and muscle mass. While physical activity is generally recognized as important for building muscle mass, it is worth noting that not all types of physical activity contribute equally to muscle development. For example, activities such as light exercise or walking for extended periods can reduce muscle mass excessively, as the body may use muscle tissue as an energy source when calorie intake is insufficient (Kadek et al., 2020).

In Cihanjuang, only 33 individuals engage in strenuous activities such as weight lifting, which is more likely to increase muscle mass. Muscle mass is highly influenced by nutrient intake, particularly protein. If someone engages in physical activity but does not consume enough protein or other necessary nutrients, muscle growth will not be optimal. This study is consistent with research conducted by Sesilia (2017) in Tanjung Banjaroyo village, where the results showed a p-value of 0.792 > 0.05, indicating no significant relationship between physical activity and body fat. Various types of physical activity have different effects on body fat reduction. Light physical activities like casual walking or daily activities may not be sufficient to burn a significant amount of calories compared to more intensive endurance or aerobic exercises. Studies indicate that individuals with lower levels of physical activity tend to have a higher body fat percentage, although this relationship is not always statistically significant. Excessive calorie intake can counterbalance the positive effects of physical activity. If someone consumes more calories than they burn through physical activity, body fat accumulation can still occur. Research suggests that, despite the negative impact of physical activity on body fat percentage, the effect of energy intake is often more dominant (Pravita et al., 2021). Overall lifestyle, including eating habits and daily routines, plays a crucial role in determining body composition. Studies show that individuals with unhealthy eating habits or high-fat diets tend to have a higher body fat percentage, even when their physical activity levels are considered (Andika et al., 2023).

This study is consistent with research conducted by Lukman (2018) in Surabaya, which found a p-value of 0,26 > 0,05, indicating no significant relationship between physical activity and age. As we age, the body's metabolism tends to slow down, primarily due to a decrease in muscle mass and hormonal changes that affect how the body burns calories. The reduction in muscle mass, which begins around the age of 30, lowers daily calorie requirements, meaning that even if a person remains physically active, the impact on biological age may not be significantly noticeable. Not all types of physical activity provide the same benefits for body health. Light or moderate activities may not be sufficient to slow the aging process or significantly improve health. Research indicates that more intense physical activities, such as resistance training or aerobic exercises, are more effective in slowing down biological aging. If a person only engages in light activities, the relationship with biological age may not be evident. Overall lifestyle, including diet and daily habits, plays a significant role in health and biological age. Poor nutrition intake can counteract the benefits of physical activity. For example, a diet high in fat and low in nutrients can accelerate biological aging, even if a

person is physically active. Therefore, the relationship between physical activity and biological age can be influenced by other factors (Simon et al., 2023).

CONCLUSION

The conclusion of this study indicates that there is no significant relationship between physical activity and muscle mass, body fat, or biological age. Although it was expected that physical activity could have a positive impact on body composition, the lack of a significant relationship between these variables may be attributed to several factors, such as diet, genetics, and overall health condition. These factors play an important role in determining body fat, muscle mass, and biological age. The findings highlight the need for further research to explore other factors that may influence muscle mass and body fat, such as lifestyle factors.

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